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Inclusion of Equity in an LED Citywide Street Lighting Replacement Program

By Peter Koonce, P.E.

Equity is a topic that's emerging in cities across the United States. As cities become more racially, ethnically, and age diverse, transportation practitioners should evolve practices that consider the needs of the community. Like other cities, there are neighborhoods in Portland, OR, USA that have not had equitable investment and access to opportunities to advance their residents' well-being and achieve their full potential.

The Portland Plan states the following: "Equity is when everyone has access to the opportunities necessary to satisfy their essential needs, advance their well-being, and achieve their full potential. We have a shared fate as individuals within a community and as communities within society. All communities need the ability to shape their own present and future. Equity is both the means to healthy communities and an end that benefits us all."[1]

Incorporating Equity into Street Lighting

In early 2013, the Portland Bureau of Transportation (PBOT) started a program to replace existing street lights with light-emitting diodes (LEDs), which offer greater energy efficiency, longer life, and higher quality illumination than previous lighting technology. The costs of LED bulbs, while higher than conventional bulbs, had fallen to a level at which they are anticipated to pay for themselves relatively quickly through reduced energy and maintenance costs. A significant body of research supports the conclusion that better street lighting also deters crime.[2] While it remains to be seen whether LEDs perform better at crime prevention in terms of light quality, their longer lives suggest that neighborhoods will suffer from fewer outages and as a result may receive a higher benefit in terms of crime prevention.

Once funding was secured for this project, the City embarked on research to determine where equity has been incorporated into similar projects. In 2002, the City of Seattle, WA, USA launched the Race and Social Justice Initiative, an effort to end institutionalized racism in city services and infrastructure. A major part of this effort was the adoption of the Equity Impact Analysis as a basic tool to be used by city agencies prior to embarking on projects. One of the first and most well-known uses of the Equity Impact Analysis was to assess the process used by Seattle City Light for streetlight relamping. The analysis found that their normal practice of relamping in response to people calling in to report non-functional streetlights resulted in racial and social disparities. Low-income people and people of color, particularly recent immigrants with limited English proficiency, were found to be less likely to report streetlight outages than people in affluent areas of the city.

In response to the Equity Impact Analysis, Seattle City Light began to do group relamping of streetlights based on the age of the lights. They also focused their efforts first on the southern area of Seattle where there is a greater concentration of low-income and minority populations.

Applying the Equity Lens in Portland

The City of Portland was committed to replacing virtually all streetlights in the city with LED lamps within two years. The analysis considered that some neighborhoods would receive new LEDs before other neighborhoods, and this could further exacerbate past inequities. Our assessment included working with the Coalition for a Livable Future (a non-profit organization) that specialized in these issues. Their assessment of the rapid and wide-scale installation of 44,000 LEDs during a 2-year period meant that the equity impact of LED relamping itself would be negligible. However, there was a significant opportunity to revisit lighting levels as lamps were replaced. Applying the equity lens to the Portland context, therefore, entailed a close look at the equity impact of lighting levels in terms of neighborhood safety and comfort. To do this, we had to understand which areas and corridors would benefit the most from higher lighting levels. To this end, the City developed an analytic method taking into account demographics, neighborhood amenities, safety issues, and active transportation routes.

Developing Analysis Factors

Demographics

Social equity can have many definitions, but a widely accepted core concept is to ensure that traditionally under-served or marginalized populations are well-served with city services and infrastructure. In some cases, this can mean that these populations are provided with extra services or receive extra attention compared to traditionally well-served populations in order to address existing, built-in disparities.

In the context of the LED relamping project, the first step in the Equity Analysis was to determine the specific populations of concern from an equity perspective, taking into account the availability of spatial and demographic data with which to perform an adequate analysis. The demographic factors chosen for the LED Equity Analysis are:

- People of Color;
- Households in Poverty; and
- Senior citizens.

These factors take into account racial and economic equity and represent populations that are too often under-served by public services and infrastructure. Other factors, such as people with disabilities or recent immigrants, were considered for the analysis, but were not feasible due to a lack of data at a fine enough scale to be useful for the LED analysis.

The National Equity Atlas
This website provides a comprehensive data resource to track, measure, and make the case for inclusive growth: http://nationalequityatlas.org.

Portland, OR, USA Equity Atlas
This resource is currently being updated: http://regionalequityatlas.org

resources

Safety

Personal safety is one of the key reasons that cities invest in street lighting systems. Generally, the safety benefits come in two forms. First, outdoor lighting can reduce crime and increase the perception of personal safety due to increased visibility. Second, people walking or bicycling within or across a street are more visible to motorists with adequate lighting, leading to transportation safety benefits. The LED analysis uses three safety factors:

- Parks;
- Schools;
- Libraries;
- Senior Housing;
- Business clusters; and
- Public facilities.

The frequency of reported crimes tells us where there may be a higher benefit from street lighting. The frequency of bicycle and pedestrian crashes tells us where lighting could provide better visibility for people who walk or bike. Finally, a lack of sidewalks indicates areas where people are more likely to walk in the street, without the buffer from traffic that a sidewalk provides.

Access

Access factors are used to indicate the likelihood that people will use the streets to access destinations by walking or bicycling, transportation modes which benefit from better street lighting. This is done by assessing the presence of existing infrastructure, transit service, and city policy. The three factors are:

- Pedestrian network;
- Bicycle network; and
- Transit network.

The pedestrian network includes designated city walkways and pedestrian districts, the bicycle network includes bike lanes and neighborhood greenways, and the transit network includes the entire bus and rail system in the city. Proximity to these networks makes it more likely that residents will walk or bike to access their destinations directly or via transit. These networks also indicate where city policy is encouraging people to use non-automobile modes of travel.

Methodology

In order to analyze and compare the relative impact of replacing street lights in various neighborhoods, PBOT developed maps for each factor using a variety of applications. The Regional Equity Atlas, an online equity mapping tool developed by the Coalition for a Livable Future, was used to show the concentration of each of the relevant equity populations by census tract. PBOT's internal geographic information systems (GIS) system is used for all the other factors except the Crime factor, which utilizes PortlandMaps.

The analysis used a 3-point scale for People of Color and Households in Poverty. Census tracts score 0 if they have less than the regional average percentage of people in that demographic group. Scores of 1 to 3 indicate how much higher the concentration is than the regional average. This system was chosen based on the wide variation found in the concentrations of race and poverty among census tracts.

The Safety and Access factors are each scored on a 2-point scale. A score of 0 indicates that the factor is not applicable to the proposed area, a 1 indicates low relevance, and a 2 indicates high relevance. While the Equity factors deal with *who* benefits from LED replacement, the Safety and Access factors indicate *how much* benefit is accrued.

Taken together, the analysis produces a score from 0 to 18 (see Table 1 for an example), representing the level at which investment in a community will have a positive impact from streetlight replacement. This prioritization system will help ensure that all things being equal, an area with a high concentration of people of color and/or people in poverty would end up higher on the project list.

Table 1. Example LED replacement evaluation system.

Criteria	Category	Measure	Score	Possible Score
Equity	Race	% people of color	3	3
	Income	% below poverty	3	3
Safety	Crime	Annual crimes per sq. mi.	2	2
	Crashes	Bike/Ped crashes	0	2
	Sidewalks	Lack of sidewalks	0	2
Access	Pedestrian	Ped District or City Walkway	1	2
	Bicycle	Bike Network	2	2
	Transit	Transit Network	0	2
Total			11	18

Results

The analysis was first performed on areas where LED replacement has already taken place in order to see if current prioritization methods are adequately taking into account equity, safety, and access factors. It found that while some areas scored fairly high, the majority of street light replacements were in areas that scored low in one or more factors.

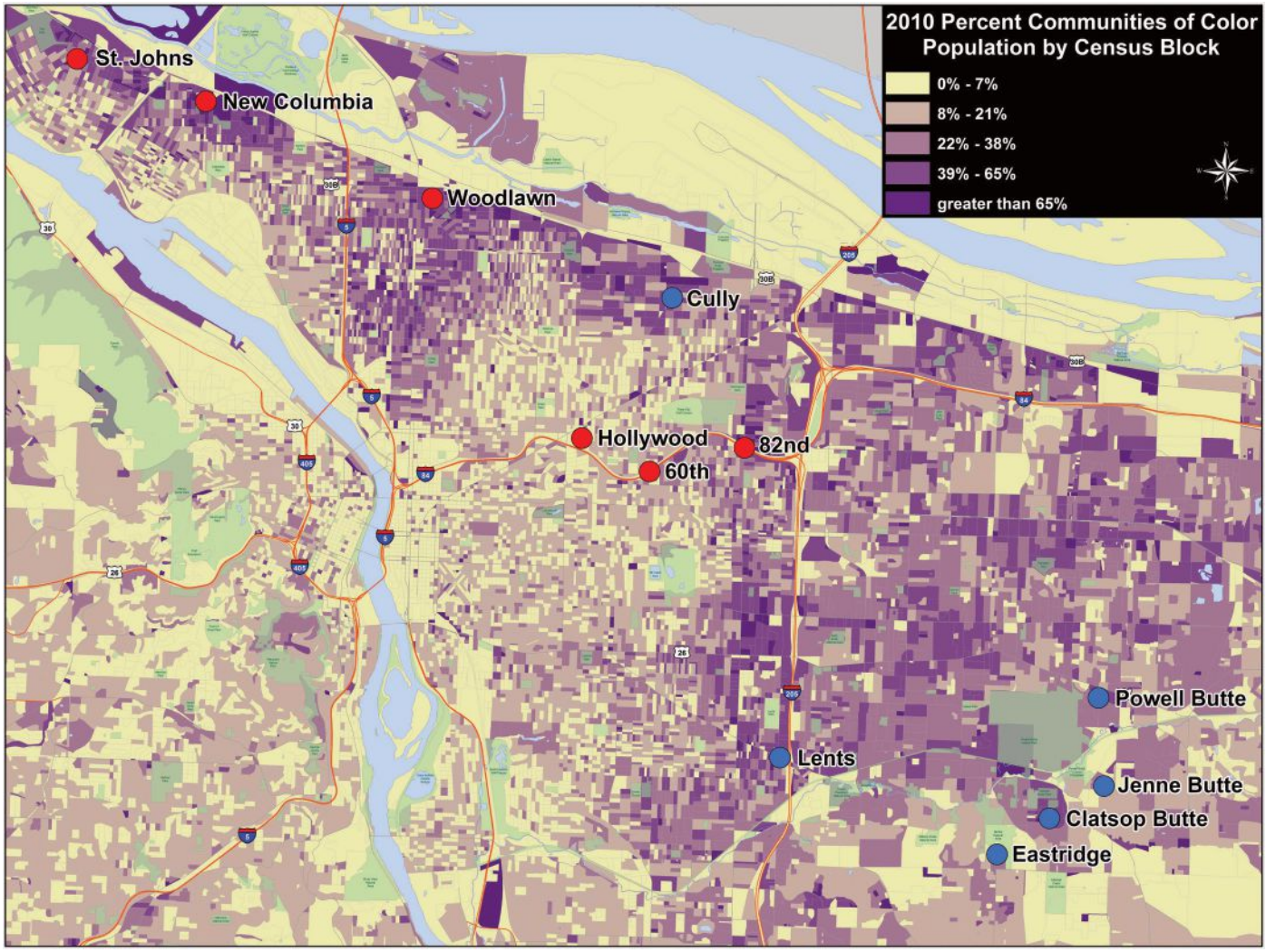
Table 2 shows the breakdown of scores for areas already replaced, and shows that while the replacements in Cully and Lents scored in the upper half of possible scores, the other replacements (mainly in the Pleasant Valley area of outer South East Portland) were not as beneficial and would have been lower priorities had this method been used at the time.

Table 2. Locations and prioritization scores of areas already replaced with LEDs.

Location	# of LEDs	Equity Score	Safety Score	Access Score	Total Score
Lents	52	5	4	6	15
Cully	20	6	2	3	11
Powell Butte	68	3	1	2	6
Eastridge	127	3	1	0	4
Clatsop Butte	139	3	0	0	3
Jenne Butte	53	0	1	0	1

The analysis was then performed on areas that are candidates for LED replacement given the age of existing street lights. Table 3 shows several areas that stood out as high priorities and are recommended for the next round of LED replacement. The New Columbia development and the stretch of North East Dekum Street in Woodlawn score particularly high, mainly due to equity factors, whereas Hollywood scored fairly high despite low equity scores due to safety issues and its important location in terms of access.

The areas adjacent to the I-84 overpasses at NE 60th Ave and NE 82nd Ave also stood out and brought a high benefit given the large numbers of pedestrians using the TriMet MAX stations and bus stops in those areas. One area of the St. Johns neighborhood scored low despite a high equity score because it does not see major safety issues and is isolated from the primary pedestrian, bicycle, and transit network. This demonstrates the way in which this tool ensures that investments are beneficial in addition to being equitable.



Portland Bureau of Transportation

This map of Portland, OR, USA shows the locations of the areas already replaced with LEDs in blue, while the candidate areas for LED replacement are shown in red.

Jonathan Maus, Bikeportland.org

This before and after photo shows a Portland, OR, USA neighborhood bikeway with the old streetlight and the new LED streetlight.

Table 3. Locations and prioritization scores of candidate areas.

Location	# of LEDs	Equity Score	Safety Score	Access Score	Total Score
New Columbia	87	6	3	4	13
Woodlawn	25	6	2	5	13
Hollywood	86	1	4	6	11
82nd	16	3	4	4	11
60th	6	3	3	4	10
St Johns	32	5	1	0	6

Conclusion

As transportation agencies continue to explore the extent that equity can be incorporated into our projects, we have an opportunity to insure our efforts address past inequities. This analysis method has been considered for other activities, including response to traffic signal maintenance requests. The equity analysis method has been designed to work with projects that span the city and is best applied using a GIS. **itej**

References

1. Portland Bureau of Transportation. "The Portland Plan." Accessed June 26, 2017: www.portlandonline.com/portlandplan/index.cfm?c=58776.
2. Farrington, David, and Brandon C. Welsh. "Effects of Improved Street Lighting on Crime: a Systematic Review." Home Office Research Study 251. 2002.

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